The Impact of the 2008 Youth Minimum Wage Reform in New Zealand

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We examine the impact of a policy reform in New Zealand that abolished the youth minimum wage for 16-17 year-old workers and resulted in a 28% increase in the real value of the minimum wage for this group using a difference-in-differences analysis where we compare changes in outcomes over time for 16-17 year-olds relative to 20-21 year-olds allowing for potential spillovers to 18-19 year-olds. We first show that, at the time of the reform, minimum wages were substantially binding for 16-17 year-olds. We find no evidence of adverse employment effects immediately following the policy change in 2008, but conclude that it lowered the employment rate of 16-17 year-olds by 3-6 percentage points in the subsequent two years, and resulted in substitution towards 18-19 year-olds. These effects were mostly borne by students: in fact, the employment rate among non-students increased; in addition, there was no increase in 16-17 year-olds' unemployment, and their overall inactivity rate decreased following 2008. Overall, we find that this large minimum wage increase had fairly small adverse effects and primarily impacted marginally attached workers suggesting that increasing minimum wages are unlikely to cause large employment losses in most circumstances.

Keywords: Minimum wage, New Zealand, natural experiment, difference-in-differences

JEL Code: J38, J22, J23, J24

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Acknowledgements: We thank Jason Timmins and participants from several seminars for comments and discussion. This research was supported by a research grant from the NZ Department of Labour. Access to the HLFS data used in this study was provided by Statistics New Zealand under conditions designed to give effect to the security and confidentiality provisions of the Statistics Act 1975. Any views expressed are the sole responsibility of the authors and do not purport to represent those of the Department of Labour/MBIE, Motu or Statistics New Zealand.

 http://dx.doi.org/10.26021/10862

I. Introduction

Prior to 2008, New Zealand's minimum wage legislation included an adult minimum wage rate that applied to workers aged 18 and over; and a youth minimum wage rate, set at 80% of the adult minimum wage, that applied to 16-17 year-old workers. In April 2008, the youth minimum wage was abolished and replaced with a *new entrants* minimum rate, set at 80% of the adult minimum wage, that applied to 16-17 year-olds for their first three months or 200 hours of employment, following which the adult minimum applied. At the same time, the adult minimum wage was increased from $11.25 to $12.00 per hour, or 2.5% in real terms. Together with this increase in the adult minimum wage, the 2008 youth minimum wage reform resulted in a 28% increase in the real value of the minimum wage faced by 16-17 year-old workers who were not eligible for the new entrants rate.

In this paper, we analyse the impact of this reform on labour market and associated outcomes for 16-17 year-olds. The reform provides a large and focused change in the minimum wage that had a large effect on the wages paid to the affected age group. We adopt a similar approach to that used by Hyslop and Stillman (2007) to analyse previous youth minimum wage reforms in 2001 and 2002. In particular, our analysis exploits the targeted nature of the policy change by comparing the outcomes of the directly affected 16-17 year-olds, before and after 2008, with the outcomes of 20-21 year-olds, who were not directly affected by the 2008 policy change. Although 18-19 year-olds were not directly affected by the reform, they were also potentially affected by firms substituting 18-19 year-old workers for 16-17 year-olds. For this reason, we consider 20-21 year-olds to be a better comparison group.

Simple difference-in-differences estimates of the impact on employment, that compare the change in the employment rate of 16-17 year-olds between the three years prior to the change (2005-07) and the three years after the change (2008-10) with the changes for both 18-19 and 20-21 year-olds show that 16-17 year-olds' employment rate dropped in relative terms by about 2.8 percentage points (or 6%) after 2008. We then use alternative regression specifications to control for various factors, most importantly age-specific business cycle effects, that may confound the estimated impact of the policy change. We find no evidence of adverse employment effects for 16-17 year-olds immediately following the policy change in 2008, but find that it lowered their employment rate by 3-6 percentage points in the subsequent two years.

Further analysis of related outcomes, including educational enrolment, unemployment and inactivity rates, indicates that most of the adverse employment effect was borne by students. In fact, the employment rate among non-students increased, while there is no evidence of an increase in unemployment, and the overall inactivity rate of this age-group decreased following 2008 suggesting a general reduction in labour supply and substitution towards educational investments. We also find evidence of employment substitution towards 18-19 year-olds, again largely among students. In addition, relative to 20-21 year-olds, we estimate the average hours worked by 16-17 and 18-19 year-olds fell after 2008, as did their earnings and total incomes.

Research on the minimum wage effects on employment remains active and contentious internationally.[1] Although much of the research is US based, reflecting the availability of geographic variation in minimum wages associated with different state, county, city, and federal minimum wage rates, minimum wage research has also become more active in other countries. In New Zealand, the minimum wage only varies at the national level over time, however, until the reform we examine here, there was a separate youth minimum wage that initially applied to workers age 20 or less (until 2001) and then to workers age 18 or less. Importantly, this youth minimum wage is generally quite binding on teenage wages, particularly for 16-17 year-olds after the initial reform in 2001 that increased the ratio of the youth minimum from 60 to 80% of the adult minimum. As noted by Dube (2019), most of the international evidence is based on situations where the minimum wage is below 60 percent of the median wage. Hence, we are able to contribute to this literature by examining a situation where the minimum wage has a much larger effect on the wages of a specific group of workers.

Our previous work examining the impact of the earlier reform in 2001 used a similar methodological approach as in this paper and found no evidence that the large increase in the

[1] For example, in a broad review of the (mostly US) international minimum wage literature, Dube (2019) reports that the median estimate of the own-wage employment elasticity (OWE) for broader groups of workers is -0.04, and -0.16 for affected groups. He concludes that, although there is variation across studies, "… the weight of the evidence suggests any job losses are quite small." (p.50). On the other hand, a series of papers by Neumark and co-authors generally find larger employment effects (e.g. Neumark, 2019; Neumark et al., 2014; Neumark & Wascher, 2011, 2017). Neumark (2015) argues that having proper counterfactuals results in adverse employment effects with elasticities in the order of -0.1 – -0.3 for young workers. Curiously, this range includes Dube's (2019) -0.16 median estimate, suggesting different interpretations of the same results (Allegretto et al., 2017).

minimum wage for 16 to 19 year-olds had a negative impact on youth employment in the years immediately after the reform (Hyslop and Stillman 2007). We also found evidence that 16-17 year olds increased their hours worked by 10-20% and suggestive evidence that the proportion of individuals continuing their education declined. We did find some weak evidence of a small employment loss after 3 years: about 2 percentage points (pp) for 18-19s (implying an elasticity of about -0.03), and 2-4 pp for 16-17s (elasticity of between -0.05 and -0.1), but still the overall impact of the reform was, on average, a large increase in labour earnings and incomes for teenagers.

The previous reform in 2001 was undertaken during a period of strong economic growth. In contrast, soon after the implementation of the 2008 reform, the global recession hit New Zealand. This had a particularly large impact on teenage employment with the employment rate of 16-17 year-olds falling by one-third from 43.1% in first quarter 2008 to 28.5% fourth quarter 2010 and the employment rate of 18-19 year-olds falling by 4.1 percentage points. Hence, this paper is able to provide evidence on the impact of a large binding minimum wage increase undertaken during an economic contraction which is an extremely rare occurrence. Our results imply that the minimum wage increase explains 20– 40 percent of the fall in employment for 16-17 year-olds with these losses occurring entirely among students who were combining study with part-time employment. Our finding that, even in these circumstances, the adverse effects of a large minimum wage increase are fairly small and primarily impact marginally attached workers suggests that increasing minimum wages are unlikely to cause large employment losses in most circumstances.

The remainder of the paper is organised as follows: In the next section, we discuss the background to the 2008 policy changes. Section III provides a description of the data used in the analysis, and describes the effects of minimum wage changes over the past decade on relevant aspects of the wage distributions of 16-21 year-old workers. In section IV, we present our analysis of the impact of the policy change on employment, hours worked and other related outcomes. The paper concludes with a discussion in section V.

II. Background

Following the 2005 general election in New Zealand, the Labour party entered into confidence and supply agreements with both New Zealand First and the Green party that included continuing to increase the (adult) "minimum wage, with a view to it being set at $12.00 per hour

by the end of 2008 if economic conditions permit" (New Zealand Labour Party's 2005 Confidence and Supply Agreement with New Zealand First). Progressive increases in the minimum wages during the 2000s resulted in the adult minimum wage being set at $12 per hour effective 1 April 2008. In addition to these agreements, the Green party sponsored a Youth Minimum Wage Bill to abolish the lower youth minimum wage rate for 16-17 year-olds, effectively lowering the age at which the adult minimum wage comes into effect from 18 to 16 years. This Bill also introduced a *new entrants* minimum rate, set at 80% of the adult minimum wage, that applies to 16-17 year-olds' first three months or 200 hours of employment. This Bill was passed into law and also became effective on 1 April 2008.

Table 1: Summary of Minimum Wage Changes

Announcement date	Effective date	Nominal minimum wage affecting			New entrants' wage
		Adults (aged 20+)	18–19 year olds	16–17 year olds	
	17 September 1990	6.13	–	–	–
	31 March 1994	–	3.68	3.68	–
	22 March 1995	6.25	3.75	3.75	–
	18 March 1996	6.38	3.83	3.83	–
	1 March 1997	7.00	4.20	4.20	–
	6 March 2000	7.55	4.55	4.55	–
14 December 2000	5 March 2001	7.70	7.70	5.40	–
30 January 2002	18 March 2002	8.00	8.00	6.40	–
19 December 2002	24 March 2003	8.50	8.50	6.80	–
23 February 2004	1 April 2004	9.00	9.00	7.20	–
21 December 2004	21 March 2005	9.50	9.50	7.60	–
21 December 2005	27 March 2006	10.25	10.25	8.20	–
18 December 2006	1 April 2007	11.25	11.25	9.00	–
19 December 2007	1 April 2008	12.00	12.00	12.00	9.60
9 February 2009	1 April 2009	12.50	12.50	12.50	10.00
27 January 2010	1 April 2010	12.75	12.75	12.75	10.20
2007-2008 Change[(1)]		2.5%	2.5%	28.2%	

Notes: [(1)] Real change, adjusted for increases in the CPI inflation.

Table 1 summarises the changes in the statutory minimum wage rates for different age groups since 1990.[2] The decade from 2000 witnessed significant changes in the minimum wages for all workers, especially teenagers. Between 2000 and 2009, the adult minimum wage was

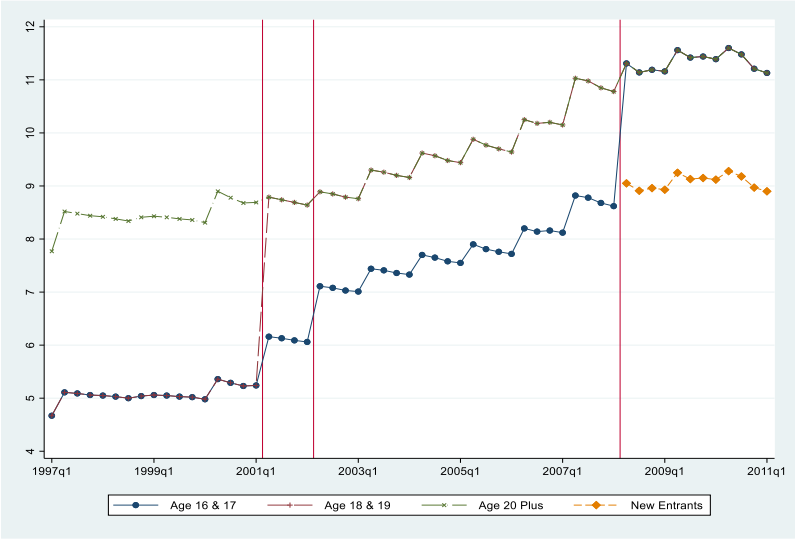
[2] In addition to the minimum wages shown in Table 1, since 2003 there has been a training minimum wage, set at 80% of the adult minimum wage, that applies to workers aged at least 16 who are doing at least 60 credits annually of recognised industry training.

progressively increased at roughly twice the rate of inflation. In addition, the youth minmum wage, which was set at 60% of the adult rate and applied to 16-19 year-old workers prior to 2001, was first abolished for 18-19 year-olds in 2001 while the ratio was raised to 80% of the adult minimum in two steps in 2001 and 2002 for 16-17 year-olds; and then abolished for 16-17 year-olds in 2008.

The focus of this paper is on the 2008 policy change which replaced the youth minimum wage by the *new entrants* minimum hourly rate. Together with the increase in the adult minimum from $11.25 to $12.00 per hour (2.5% in real terms), the immediate effect of this change was to increase the minimum wage applying to 16-17 year old workers from $9.00 to $9.60 (a 2.5% real increase) per hour for new entrants, or $12.00 per hour (a 28% real increase) for other 16-17 year-olds.

Figure 1 describes the trends in the real minimum wages (expressed in June 2006 dollar values), that applied to 16-17 and 18-19 year olds, and adult (aged 20 years and over) workers, and the *new entrants* rate since 1997. First, the figure shows that the real value of the adult minimum wage increased steadily between 2000 and 2009. In fact, the adult minimum wage increased 36% between 1999 and 2009 (3.1% annually), of which about one-half (19%) of the increase occurred between 2003 and 2007. Second, the three vertical lines in this figure highlight the increases in the minimum wage applying to teenage workers associated with youth minimum wage reforms in 2001 and 2002, and in 2008. Collectively, these reforms together with the adult minimum wage increases resulted in the minimum wage applicable to teenagers increasing by 126% in real terms between 1999 and 2009.

Figure 1: Real Minimum Wage (2006 $s), by Age Group



Notes: Vertical lines correspond to dates of the 2001, 2002, and 2008 youth minimum wage reforms.

Hyslop and Stillman's (2007) analysis of the youth minimum wage reforms in 2001 and 2002 relied on young adults (aged 20-25) being unaffected by the changes and providing a counterfactual for the labour market outcomes of teenagers that were affected by the reforms. The analogous preferred identification strategy for this study would be to treat the outcomes of 18-19 year olds as the counterfactual for the directly affected 16-17 year old age group. However, there are two potential issues with this counterfactual. First, given the significant increases in adult minimum wages over the period, by 2008 it is questionable whether 18-19 year olds were unaffected by minimum wages. Second, any adverse effects on 16-17 year olds' employment may result in positive spill-over effects on 18-19 year olds' employment. For these reasons, we will largely treat the outcomes of 20-21 year olds as the counterfactual for measuring the impacts of the minimum wage changes on teenage outcomes.

III. Data

Our analyses are based on survey data from the quarterly Household Labour Force Survey (HLFS), and the annual June-quarter Income Supplement (HLFS-IS, also known as the New Zealand Income Survey, NZIS). The HLFS began in 1986 and collects information on labour force status, hours worked, educational status together with sociodemographic information on individuals and their households. The core HLFS sample collects no information on wages or incomes but, since 1997, an annual supplement to the June-quarter HLFS collects information on

wages and salaries, self-employment income, public transfers and other sources of income. The HLFS sample frame uses an eight-quarter rotating panel with about one-eighth of the sample rotating in/out each quarter, and consists of a representative sample of approximately 15,000 households and 30,000 individuals.

The focus of our analysis is on the impact of the 2008 youth minimum wage policy changes on 16-17 year-olds' employment and related outcomes. For this purpose, we construct samples of 16-21 year-olds from both the quarterly HLFS and the annual HLFS-IS samples. Our analysis of non-income related outcomes of interest – wage and salary employment, weekly hours worked, self-employment, studying, unemployment, and inactivity – uses the quarterly HLFS data; while our analysis of four income-related outcomes – hourly wages, receipt of non-student benefits, weekly earnings, and weekly total income – uses annual data from the HLFS-IS. We include in our samples all available data on individuals aged 16-21, including that collected by proxy interview and/or imputed when missing but, in our analysis, we include fully interacted controls for these observations, as such data is likely to contain significant measurement error.

Our main analyses use data pertaining to 16-21 year-olds from each of these sources over the period 1997–2010, but we also consider analyses over a longer HLFS coverage period 1986–2010, and over a more recent sample period 2004–2010.[3] There was a significant change in HLFS questionnaire in 2004 (June quarter) to collect consistent educational enrolment information from all respondents; prior to 2004, this was only systematically collected for those out of the labour force. Table 2 presents a summary of relevant sample characteristics over these periods for both the quarterly HLFS samples (Table 2(a)), and the annual HLFS-IS samples (Table 2(b)). For each sample, we summarise the characteristics of the full sample as well as the subsample of (wage and salary) workers. The summary statistics (and subsequent analyses) are weighted by the HLFS sampling weights created by Statistics New Zealand that take account of the HLFS sample frame and non-random survey response and attrition.

[3] We focus on the period up to 2010 in order to avoid picking up the effect of the post-recession rebound in the economy.

Table 2(a): Sample Characteristics – HLFS Quarterly Samples

	1986-2010		1997-2010		2004-2010	
	Full sample	**Workers**	**Full sample**	**Workers**	**Full sample**	**Workers**
Age	18.5	18.7	18.4	18.7	18.4	18.7
	(0.003)	(0.004)	(0.004)	(0.006)	(0.006)	(0.008)
Female	0.495	0.481	0.490	0.477	0.490	0.475
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Married	0.083	0.090	0.084	0.095	0.088	0.101
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
NZ born	0.819	0.860	0.814	0.866	0.794	0.846
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Pakeha	0.503	0.559	0.612	0.714	0.589	0.693
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Māori	0.147	0.111	0.190	0.156	0.193	0.159
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Pacific Islander	0.054	0.037	0.073	0.053	0.075	0.053
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Asian	0.053	0.030	0.082	0.049	0.099	0.065
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Wage & salary worker	0.543	1	0.527	1	0.528	1
	(0.001)		(0.001)		(0.002)	
Weekly hours	28.2	28.2	26.4	26.4	26.2	26.2
	(0.041)	(0.041)	(0.059)	(0.059)	(0.085)	(0.085)
Self employed	0.010	0.000	0.008	0.000	0.007	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Studied (standard Qs)	0.252	0	0.281	0	0.288	0
	(0.001)		(0.001)		(0.002)	
Studied (all sources)					0.609	0.490
					(0.002)	(0.002)
Unemployed	0.095	0	0.088	0	0.085	0
	(0.001)		(0.001)		(0.001)	
Inactive (standard Qs)	0.190	0	0.180	0	0.173	0
	(0.001)		(0.001)		(0.001)	
Inactive (all sources)					0.116	0
					(0.001)	
No. Observations	328,110	173,563	161,719	83,469	77,198	40,032

Notes: Samples are restricted to individuals aged 16-21 years. Estimated standard errors are in parentheses. All summary statistics are weighted by the HLFS sampling weights. Hours worked are conditional on wage and salary employment.

Table 2(b): Sample Characteristics – HLFS-IS Annual Samples

	1997-2010		2004-2010	
	Full sample	Workers	Full sample	Workers
Age	18.4	18.7	18.4	18.7
	(0.009)	(0.012)	(0.012)	(0.017)
Female	0.490	0.478	0.491	0.474
	(0.003)	(0.004)	(0.004)	(0.005)
Married	0.082	0.093	0.086	0.099
	(0.001)	(0.002)	(0.002)	(0.003)
NZ born	0.811	0.865	0.792	0.845
	(0.002)	(0.002)	(0.003)	(0.004)
Pakeha	0.611	0.711	0.586	0.691
	(0.002)	(0.003)	(0.004)	(0.005)
Māori	0.189	0.157	0.193	0.158
	(0.002)	(0.003)	(0.003)	(0.004)
Pacific Islander	0.072	0.051	0.074	0.051
	(0.001)	(0.002)	(0.002)	(0.002)
Asian	0.083	0.052	0.098	0.068
	(0.001)	(0.002)	(0.002)	(0.003)
Wage & salary worker	0.514	1	0.516	1
	(0.003)		(0.004)	
Weekly hours	25.7	25.7	25.5	25.5
	(0.119)	(0.119)	(0.168)	(0.168)
Self employed	0.007	0.000	0.006	0.000
	(0.000)	(0.000)	(0.001)	(0.000)
Studying (incl. student bens)	0.473	0.250	0.476	0.251
	(0.003)	(0.003)	(0.004)	(0.004)
Unemployed	0.086	0	0.084	0
	(0.001)		(0.002)	
Inactive (incl. student bens)	0.133	0	0.130	0
	(0.002)		(0.002)	
Received benefits	0.110	0.040	0.095	0.033
	(0.002)	(0.001)	(0.002)	(0.002)
Real hourly wage		11.89		12.42
		(0.048)		(0.052)
Real weekly earnings		334.6		349.6
		(1.8)		(2.6)
Real total weekly income	213.0	352.1	218.3	366.2
	(1.2)	(1.7)	(1.8)	(2.5)
No. Observations	38,885	19,577	19,173	9,719

Notes: Samples are restricted to individuals aged 16-21 years. Estimated standard errors are in parentheses. All summary statistics are weighted by the HLFS sampling weights. Hours worked and earnings are conditional on wage and salary employment. Earnings and incomes are in constant (2006) $-values.

Our 1997–2010 quarterly HLFS samples have 161,719 observations, and 83,469 (53%) wage and salary workers; and the 1997–2010 annual HLFS-IS samples have 38,885 observations,

and 19,577 (51%) wage and salary workers.[4] Less than 1% of 16-21 year-olds were self-employed, 28% studying (based on the pre-2004 information collected), 9% were unemployed and 18% were inactive. [5] The summary statistics vary somewhat across the other sample periods, but are reasonably representative. The measured study rate is substantially higher (61% versus 29%) once additional data is collected on individuals who are in the labour force and studying starting in 2004.

Comparing the full and worker-samples for each period, workers are, on average, older, more likely to be male, New Zealand born and Pakeha, and less likely to be studying, than non-workers. Wage and salary workers work about 26 hours per week on average, and earn $11.89 per hour (2006 $-values). Both the wage and salary employment rate, and average weekly hours worked, are slightly higher in the quarterly HLFS than the annual HLFS-IS samples, presumably reflecting seasonal differences, but otherwise the sample characteristics are very similar.

Before we analyse the impact of the 2008 minimum wage changes on teenage outcomes, we first provide a description of the changes in the wage distributions of teenagers and young adults over the period before and after 2008. This provides a sense of how much the prevailing minimum wages affected teenage and young adult workers before the youth minimum was abolished in 2008, as well as how much the 2008 change affected 16-17 year-olds' wages.

A. The New Entrants Wage Effects

We begin by considering the extent to which the *new entrants* minimum hourly rate appears to be a relevant minimum rate for 16-17 year-olds after 2008. This rate was set at 80% of the adult

[4] These samples imply age-specific average cell sizes of 481 (and 248 workers) per quarter in the HLFS, and 463 (and 233 workers) annually in the HLFS-IS.

[5] Individuals are coded as studying if they are i) out of the labour force and record study as their main activity or, ii) report that they are still in school when asked about their qualifications. The rate here is slightly lower than in Hyslop and Stillman (2007) because, in that paper, supplemental questions on why individuals left their last job and why they are not available for work are used to code some individuals who were not employed as studying. The information needed to do this is no longer available in the version of the data to which we have access. Our measure of unemployment is the percentage of the total population that is out of work and searching for a job as opposed to the standard unemployment rate defined as the percentage of the labour force. This is done so all our rate measures have the same denominator. Inactivity is defined is being neither employed nor studying. We do not exclude individuals taking care of children as is done in the official Statistics NZ definition because we do not want to preclude this as a pathway out of employment.

minimum wage, and applied to the first 200 hours or 3 months of employment. In the HLFS data, it is not possible to identify whether the relevant minimum wage rate applicable to an individual 16-17 year-old is the new entrants rate or the adult minimum. However, in order to try to assess the extent to which employers may have paid 16-17 year-olds below the adult minimum wage, Figure 2 plots the trends in the fractions of 16-17 year-olds' wages in relation to each of the new entrants (or youth minimum wage prior to 2008) and the adult minimum wage.

Figure 2: 16-17 Year-Old Wage Trends

Notes: Vertical lines correspond to dates of the 2001, 2002, and 2008 youth minimum wage reforms.

First, Figure 2(a) shows the fraction of workers whose wage is, respectively, below or exactly-at the current new entrants minimum wage, and below the next year's new entrants minimum wage. As the minimum wages increased during the 2000s, there was a steady increase in the fraction of 16-17 year-olds with current wages below the next year's youth minimum wage, peaking at 32% in 2007, before falling to less than 10% after the 2008 changes. The fraction of workers with reported wages below the current youth/new-entrants minimum was never more than

11%, and was lower after 2008 (4-7%) than before (9-11% between 2003 and 2007). Also, except for 2007 when 13% of workers reported wages at exactly the youth minimum (presumably largely due to the minimum wage being exactly $9 per hour in 2007), this fraction has been less than 3% since 2003, and less than 2% since 2008.

Figure 2(b) shows the corresponding fractions of 16-17 year-olds with wages in relation to adult minimum wage rates since 1997. More than 40% of 16-17 year-olds reported wages below the (current) adult minimum rate between 2003 and 2007, and this fraction dropped to 20% in 2008-09, before rising to 35% in 2010. There was also a dramatic increase in the fraction earning exactly the adult minimum from about 4% before 2008 (curiously more than the fraction earning the youth minimum), to around 40% in 2008-09 and 28% in 2010.

In Figure 2(c), we describe the trend in the fraction of 16-17 wages that lie between the youth/new-entrant and adult minimum wages over the period, together with the sub-fraction that lies near (up to $0.50 above) the youth/new-entrants minimum, and the fraction that lies near (within $0.50 below) the adult minimum wage. This shows a generally declining trend in the fraction between the two minima bounds until 2007, followed by a substantial drop in 2008, and a noticeable increase again in 2010. The fraction of 16-17 year-olds' wages that lie near the new entrant minimum wage is less than 5% after 2008 and, while the fraction near the adult rate is also low in 2008 and 2009, it is nearly 20% in 2010 and accounts for most of the fraction between the two bounds in that year.

Finally, Figure A1 in the appendix describes in detail the histograms of wages (rounded to the nearest $0.10) between the youth/new-entrant and adult minimum wages for 16-17, 18-19, and 20-21 year-olds in each year since 2007. These histograms show the fraction of all wages at each $0.10 value, and highlight several effects. First, the binding nature of the youth minimum on 16-17 year-olds' wages, and the adult minimum on 18-19 year-olds' wages, in 2007 (Figure A1(a)). Second, the huge clearing effect on wages below $12 of the 2008 changes (Figure A1(b)). Third, the relative importance of round $1 and $0.50 reported wages, which are particularly noticeable at $12 and $12.50 for both teenage groups in Figure A1(c) and (d). We believe such round-wage reporting contributes to the substantial fraction of wages at a minimum wage when it coincides with a round value. Also, given that about 10% of 18-19 year-olds also report $12.50 wages in 2010, we suspect the prevalence of sub-adult minimum wages for 16-17 year-olds in 2010 may be

largely due to reporting errors associated with round wage values rather than firms paying such wages in accordance with the new entrants minimum wage floor.

Although not definitive, we believe these patterns suggest the new entrants wage was largely non-binding after 2008. In addition, we suspect that, in practice, there may be significant issues associated with i) the information employers require about young workers' employment experience and ii) wage equity across their workers that inhibit employers using the new entrants rate. Below, we also show that, after 2008, the adult minimum wage appears to have a substantial binding effect on the wage distribution of 16-17 year-old workers. For these reasons, in our subsequent analysis, we will assume that the adult minimum wage is the relevant minimum wage for all 16-17 year-olds after 2008.

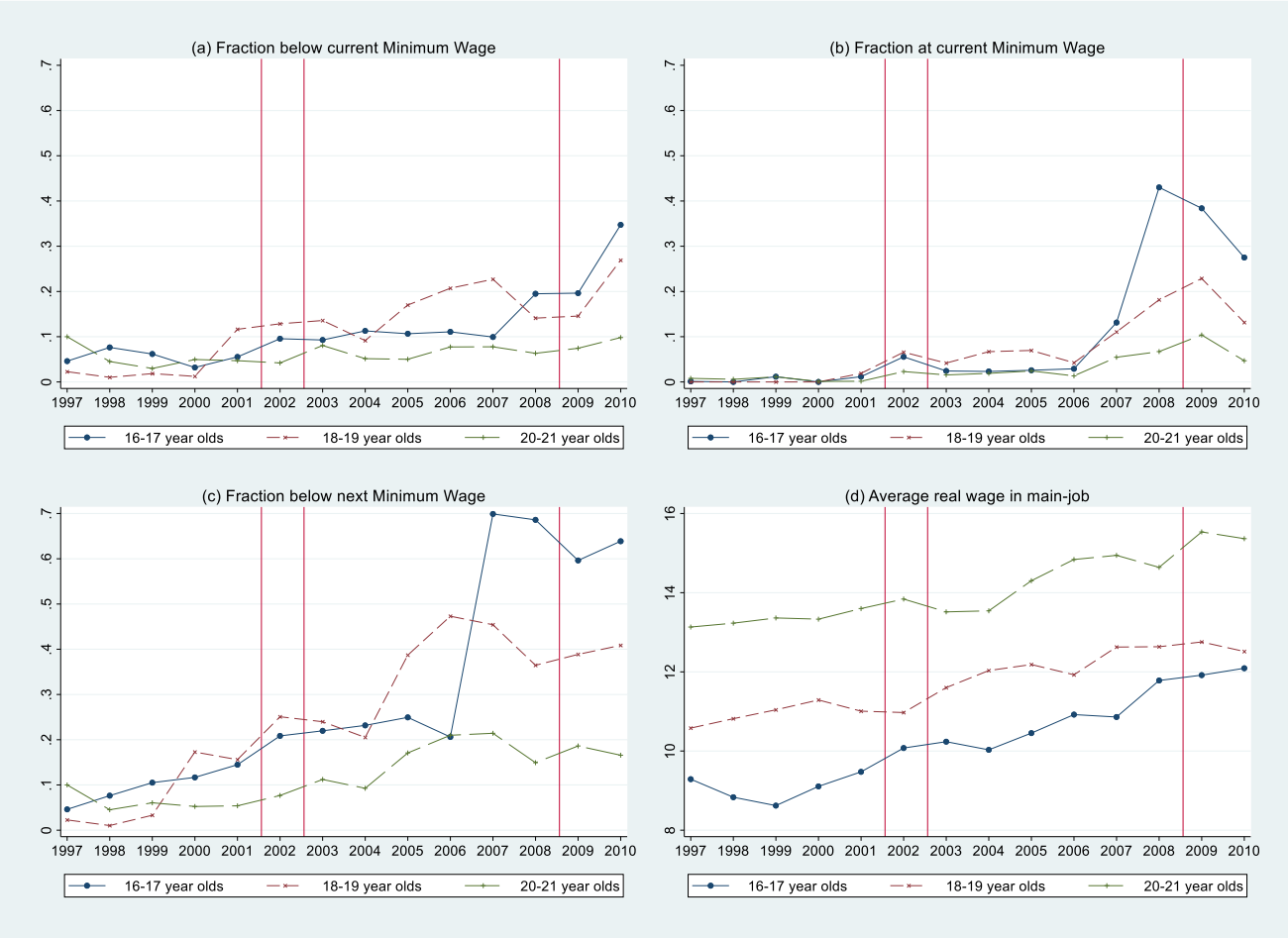
B. Changes in the Wage Distribution

We now show time trends in the wage distribution summary statistics across the age groups. Figure 3 summarises relevant aspects of the hourly wage distributions of teenage and young adult workers estimated from the HLFS-IS over the period from 1997 to 2010. In each graph, we plot the annual trends for 16-17 year olds (dashed lines), 18-19 year olds (solid lines), and 20-21 year olds (dotted lines), and the vertical lines mark the dates of youth minimum wage reforms.

First, Figure 3(a) shows the fraction of wage and salary workers whose reported main-job hourly wage is below the current minimum wage that applies to each age group.[6] Around 5% of 16-17 year old workers reported sub-minimum wages prior to the 2001 change; this fraction increased to about 10% in 2002 and stayed around that level through until 2007, before increasing to 20% in 2008 and 2009 and 35% in 2010. For 18-19 year olds, only 1-2% reported sub-minimum wages prior to 2001, while the fraction increased steadily from about 10% in 2001 to 23% in 2007, before falling to 14-15% in 2008 and 2009 and rising to 27% in 2010. Although the fraction for 20-21 year old workers reporting wages below the minimum wage appears to have increased over the period, this fraction remained below 10% over the entire period.

[6] Note that, in Figure 3, the relevant minimum wage for 18-19 year-olds changes from the youth minimum to the adult minimum wage in 2001, and for 16-17 year-olds from the youth minimum to the adult minimum wage in 2008.

Figure 3: Real Wages (2006$s) and the Minimum Wage, by Age Group



Notes: Vertical lines correspond to dates of the 2001, 2002, and 2008 youth minimum wage reforms.

Second, Figure 3(b) shows the fraction of workers who report exactly minimum wage rates in each year. This provides one measure of the extent to which the minimum wage is binding. Prior to the 2001 changes, almost no workers (less than 1%) in any age group reported earning exactly the minimum wage. Between 2001 and 2006 there are noticeable increases for both teenage groups (up to 7% for 18-19 year olds) and a marginal increase for 20-21 year olds. However, these trends change dramatically from 2007. The fraction of 16-17 year-olds reporting exactly the minimum wage is 13% in 2007, 43% in 2008, 38% in 2009, and 28% in 2010. Less dramatic, but substantial increases also occur for 18-19 year-olds, from 11% in 2007 to 23% in 2009 and 13% in 2010, while the fraction of 20-21 year-olds increases to 10% in 2009 before falling to 5% in 2010.

Third, Figure 3(c) shows the fraction of workers in each year who report wage rates below next year's (nominal) minimum wage. This provides a measure of the fraction of workers whose

wages are directly affected by next year's minimum wage.[7] For all three age groups, this fraction tends to increase over the period from 2000. For 20-21 year-olds, this presumably reflects the steadily increasing real value of the adult minimum wage, so that by 2006 around 20% of 20-21 year-old workers have wages less than the next year's minimum. The increases are more dramatic for the teenage groups. For 18-19 year-olds, the fraction increases from less than 5% in 1999 to 17% in 2000 (in anticipation of the 2001 youth reforms), and continues to increase to around 45% in 2006 and 2007 before falling back to under 40% in 2008 and 2009. For 16-17 year-olds, the fraction increases steadily from about 10% in 1999 to 20-25% in 2005 and 2006, before jumping dramatically to around 70% in 2007 and 2008, and then falling to 60% in 2009. The 2007-8 fractions suggest that nearly three-quarters of 16-17 year-old workers were potentially affected by the abolition of the youth minimum wage in 2008.

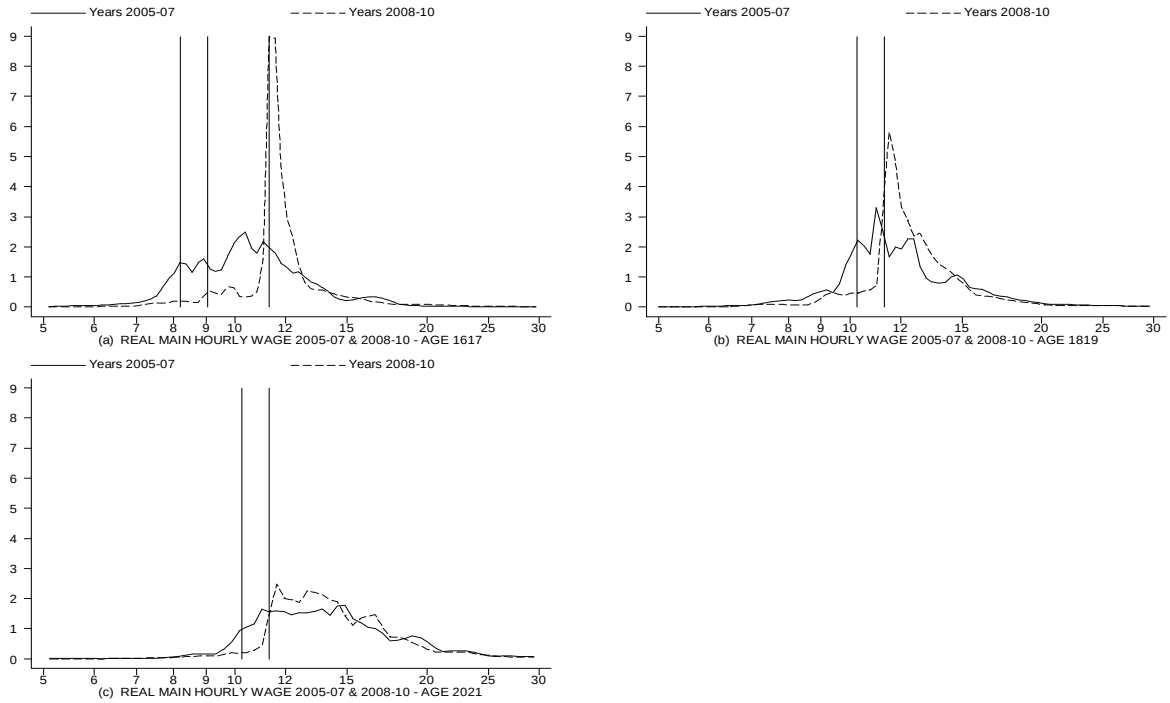
Finally, Figure 3(d) shows the trends in the average real hourly wage of the three age groups (in 2006$s). Although the real wages of each group show increases over the period, more importantly the average wage of 16-17 year-olds increases substantially (8.5%) in 2008, and shows significant convergence towards the average of 18-19 year olds after 2007. Between 1999 and 2009, the real average hourly wage of 16-17 year-old workers increases 35%, compared to 18% for 18-19 year-olds and 17% for 20-21 year-olds. Perhaps surprisingly, although the minimum wage changes over the period appear to have become increasingly binding for 18-19 year-olds, the average wage of this group has not increased noticeably more than for 20-21 year-olds.

Next, Figure 4 presents kernel density estimates of the distributions of log(real hourly wage) from workers' main-jobs, separately for 16-17, 18-19, and 20-21 year-old workers for the three year periods before and after the 2008 change – i.e., 2005-07 and 2008-10 respectively. In each figure, we have also included vertical lines corresponding to the 2006 and 2008 relevant age-group minimum wage levels. The changes in the wage distribution for these groups are consistent with the patterns of summary statistics shown in Figure 3. For example, Figure 4(a) shows a large drop in the density in the left hand tail of the distribution, together with a large spike around the adult minimum wage, for 16-17 year-olds after 2008. Also, Figure 4(a) provides further support to

[7] Assuming the nominal wage distribution is increasing, and because it ignores any secular increases in wages that may occur before the minimum wage change, this should provide an upper bound estimate of the fraction of workers directly affected by next year's minimum wage.

the notion that, after 2008, the adult minimum provides a more relevant minimum wage for 16-17 year-olds than does the new entrant minimum rate. Analogous, although less extreme effects can be seen for 18-19 year-olds in Figure 4(b); and there are much smaller, albeit noticeable, changes in the distribution of 20-21 year-olds' wages in Figure 4(c).

Figure 4: Hourly Wage Distributions (2006$s), by Age Group



Notes: In (a) vertical lines at 2006 youth minimum, and 2008 new entrants and adult minimum wages; in (b) and (c) vertical lines at 2006 and 2008 adult minimum wages.

Taken together, the patterns of changes observed in Figure 3 and Figure 4 indicate that the 2008 youth minimum wage change clearly had a large impact on the wages of 16-17 year-olds. It appears that the changes in the adult minimum wages around this time also potentially had a significant impact on the wages of 18-19 year-olds, and these increases were affecting the wages of 20-21 year-olds by the end of the period.

C. Descriptive Trends in Labour Market Outcomes

We now describe the trends in various labour market and related outcomes of teenagers and young adults for assessing the impacts of the abolition of the youth minimum wage in 2008. The key labour market outcomes are the wage and salary employment rate, which captures the extensive margin of employment, and the hours worked conditional on being employed, which

captures the intensive margin. In addition to these outcomes, we also consider the related outcomes of self-employment, unemployment, studying, and inactivity (defined as neither employed nor studying), which are each measured quarterly in the HLFS; and welfare-benefit receipt, employment earnings, and total income, which are each measured annually in the HLFS-IS.[8]

Figure 5 graphs the trends in each age-group's wage and salary employment rate, self-employment rate, and average weekly hours worked by wage and salary workers over the period 1986–2010. The three vertical lines in each graph correspond to the dates of the youth minimum wage reforms during the period – in 2001, 2002, and 2008. Each of the three graphs shows differences in both employment and hours worked across the age groups, particularly between 16-17 year-olds and the older two groups.[9] Also, it is interesting to note that prior to 2008 the employment and average hours patterns were procyclical over the business cycle, with a strong cyclical pattern from 1986 up until 1997 and a weaker cyclical pattern during the post-1997 growth period. Reassuringly for our identification strategy, the impact of the last large recession in 1991 on employment was quite similar for 16-17 year-olds and the older two groups. If the same holds true for the 2008-09 recession, then the impact of the business cycle on employment can be controlled for by comparing changes in outcomes for the different age groups.

Figure 5(a) also shows that the wage and salary employment rate of 16-17 year-olds dropped substantially after 2008, while there are smaller declines for 18-19 and 20-21 year-olds. For example, the employment rate of 16-17 year-olds fell by one-third (14.6 percentage points) from 43.1% in first quarter 2008 to 28.5% in fourth quarter 2010. By comparison, the employment rate of 18-19 year-olds fell 4.1 percentage points from 57.3% to 53.1% over the same period, and that of 20-21 year-olds appears to have trended down also, although was 60.6% in both first quarter 2008 and fourth quarter 2010. Figure 5(b) shows the self-employment rates of these age-groups are both low and variable over the period, with little discernible difference.

[8] See footnote 4 for variable definitions.

[9] The average wage and salary employment rate over the period since 1997 for 16-17 year-olds is 41.7% versus 56.5% for 18-19 year-olds and 61.1% for 20-21 year-olds; while the self-employment rates are 0.4%, 0.7% and 1.4% respectively. Similarly, average hours worked per week are 17.7, 28.3 and 31.1 for 16-17, 18-19, and 20-21 year-olds, respectively.

Figure 5: Employment and Hours Worked, by Age Group

Notes: Vertical lines correspond to dates of the 2001, 2002, and 2008 youth minimum wage reforms.

Figure 5(c) shows that the average hours worked by both teenage groups also declined over the latter part of the period, although these trends appear to begin before 2008: from about 2007 for 16-17 year-olds, and perhaps from as early as 2004 for 18-19 year-olds. From the first quarter 2008 to the final quarter 2010, the average weekly hours worked by 16-17 year-olds fell 2.5 hours per week (14%) from 17.6 to 15.1 hours (from a high of 21.0 in the fourth quarter 2006); in comparison, 18-19 year-olds' average hours worked fell 2.6 hours per week (10%) from 26.9 to 24.3 (from a high of 31.4 in the fourth quarter 2005), and 20-21 year-olds' average hours worked were 30.8 and 30.9 in these quarters, respectively.

To the extent that business cycle effects are similar for each age-group, these comparative changes in employment rates and hours worked by the various age groups suggest the abolition of the youth minimum wage in 2008 had a potentially strong impact on both dimensions of

employment for 16-17 year-olds. We will explore this more formally in a regression analysis since it is necessary to control for other potentially confounding differences to confirm this hypothesis.

We next consider the trends in the three related outcomes of unemployment, studying and inactivity, graphed in Figure 6 for the three age groups. Figure 6(a) shows the percentage unemployed of the three age-groups over the 1986–2010 period. This graph shows that unemployment is more strongly (counter)cyclical than the employment rate in Figure 5(a). The percentage unemployed for all three groups increases strongly during the recession period from first quarter 2008 until second quarter 2009, from 8.1% to 13.5% for 16-17 year-olds, 7.8% to 10.6% for 18-19 year-olds, and from 4.8% to 10.5% for 20-21 year-olds, and stays around these levels until the end of the period.

Figure 6: Studying, Unemployment, and Inactivity, by Age Group

Notes: Vertical lines correspond to dates of the 2001, 2002, and 2008 youth minimum wage reforms.

In Figure 6(b), we show the trend in the rate of studying for each age group over the 1986–2010 period, with additional information graphed for the 2004–2010 period when a more

consistent measure of studying activity was collected by the HLFS. Studying trends upwards for each age group over most of the period and, if anything, the rates for teenagers appear to increase relative to that of 20-21 year-olds after 2008 regardless of which set of figures are examined. For example, between fourth quarters in 2007 and 2010, the study-activity rate of 16-17 year-olds using the more accurate study measure increased from 80.3% to 86.7%, compared to increases from 46.3% to 54.9% for 18-19 year-olds and from 45.3% to 45.5% for 20-21 year-olds.

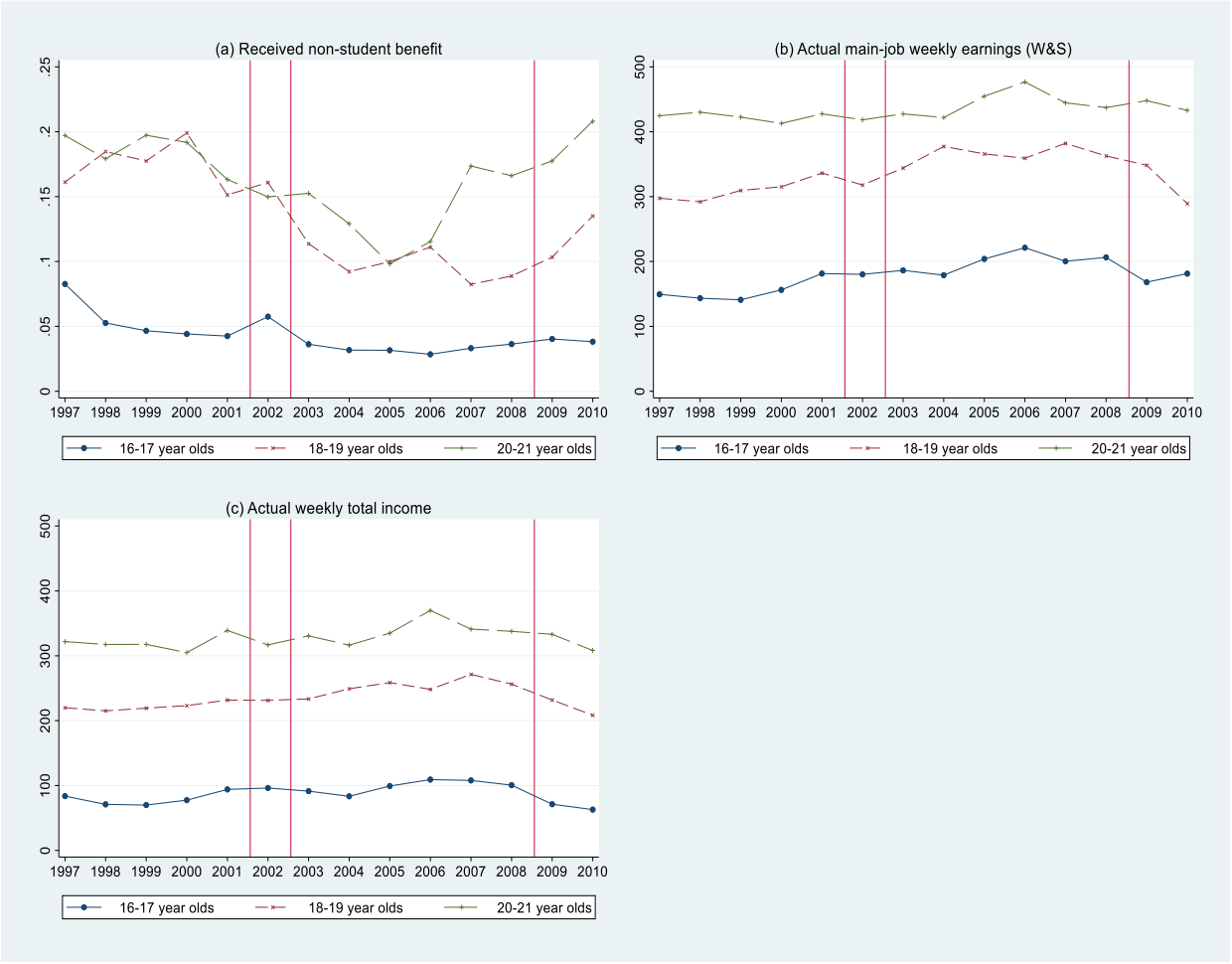
Figure 6(c) shows the trends in inactivity rates for the three age groups since 1986, again with revised more accurate numbers available since 2004. The trends in this graph largely follow those of unemployment in Figure 5(a), except at relatively different levels across the age groups, reflecting the fact that inactivity includes the unemployed, as well as those neither employed nor studying and not actively looking for work.

Finally, in Figure 7, we graph the annual trends in the fractions of individuals reporting non-student benefits (Figure 7(a)), average weekly main-job earnings conditional on employment (Figure 7(b)), and average weekly total income (Figure 7(c)) for the three age groups from the HLFS-IS over the period 1997–2010. The benefit receipt trend is quite strongly countercyclical for 20-21 year-olds, less so for 18-19 year-olds, and barely so for 16-17 year-olds, with the rates increasing after 2006, but no obvious break in trend around 2008.

The average real weekly earnings of 20-21 year-old workers are comparatively flat over the full period. In contrast, the average earnings of teenage workers increase up until 2006/7. For example, 18-19 year-olds' average earnings increase 21% between 2000 and 2007, and then decline 24% through to 2010; while, for 16-17 year-olds, average earnings increase 42% from 2000 to 2006, and then decline 18% though to 2010. Some of the difference between the relative declines in the teenage groups' average earnings is that the higher wages for 16-17 year-olds following 2008 act to off-set their lower hours worked.

Figure 7(c) presents the trends in average unconditional real total incomes for the three age groups. This measure is immune to non-random selection effects associated with employment, because individuals' total income aggregates their employment, hours worked and wages as well as any study or welfare benefit income received. The trends in average total income are similar to

Figure 7: Benefit Receipt, Earnings, and Total Income, by Age Group



Notes: Vertical lines correspond to dates of the 2001, 2002, and 2008 youth minimum wage reforms.

those for average earnings, but show relatively stronger decreases after 2007: average income declined 42% for 16-17 year-olds, versus 23% for 18-19 year-olds and 10% for 20-21 year-olds.

IV. Analysis of the Impact of Youth Minimum Wage Changes

A. Difference-in-Differences Estimates of Employment and Hours Worked

We being our analysis of the impact of the 2008 abolition of the youth minimum wage on labour market outcomes of 16-17 year-olds, with simple difference-in-differences estimates of the impact on their (wage and salary) employment rate and the average weekly hours worked conditional on being employed. While conceptually 18-19 year-olds provide the more natural comparison group for 16-17 year-olds' outcomes than do 20-21 year-olds, as shown in Figure 3 and Figure 4, by 2008, 18-19 year-olds' wages were also potentially significantly affected by the

minimum wage. For example, any direct impact on 16-17 year-olds may have resulted in employers substituting 18-19 year-old workers. Hence, we consider difference-in-difference estimates of 16-17 year-olds' outcomes relative to those of both 18-19 and 20-21 year-olds.

Table 3 summarises the levels and changes in employment and hours worked for 16-17, 18-19 and 20-21 year-olds during the two years (2006Q1–2007Q4) before the change was announced and the two years (2008Q2–2010Q1) after it occurred. Panel (A) focuses on employment, and shows the employment rate before (row 1) and after (row 2) the change for each age-group, the change in employment rate between the two periods (row 3), as well as the differences in employment rates between 16-17 and 18-19 year-olds (column (4)) and between 16-17 and 20-21 year-olds (column (5)). The entries in bold in columns (4) and (5) or row 3, are the difference-in-differences estimates of the impact on 16-17 year-olds' employment rate. Panel (B) presents analogous estimates for hours worked.

Table 3: D-in-D Estimates of Impacts on Employment and Hours Worked

	Age group			**Difference (16-17 from)**	
	16-17	**18-19**	**20-21**	**18-19**	**20-21**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
	(A) Wage and salary employment				
1. Before (2006Q1 - 2007Q4)	0.449	0.604	0.644	-0.154	-0.195
	(0.007)	(0.008)	(0.010)	(0.010)	(0.012)
	[8,725]	[6,853]	[6,398]		
2. After (2008Q2 - 2010Q1)	0.376	0.557	0.599	-0.181	-0.223
	(0.006)	(0.008)	(0.008)	(0.010)	(0.010)
	[9,419]	[7,805]	[7,149]		
3. Difference (After-Before)	-0.074	-0.047	-0.045	**-0.027**	**-0.028**
	(0.009)	(0.011)	(0.013)	**(0.014)**	**(0.016)**
	(B) Main-job actual hours worked				
1. Before (2006Q1 - 2007Q4)	18.77	29.32	31.31	-10.55	-12.55
	(0.31)	(0.28)	(0.31)	(0.41)	(0.44)
	[3,910]	[4,069]	[4,126]		
2. After (2008Q2 - 2010Q1)	15.79	26.23	29.36	-10.44	-13.57
	(0.29)	(0.37)	(0.37)	(0.47)	(0.47)
	[3,534]	[4,160]	[4,208]		
3. Difference (After-Before)	-2.98	-3.09	-1.96	**0.11**	**-1.03**
	(0.42)	(0.46)	(0.49)	**(0.63)**	**(0.65)**

Notes: Estimated standard errors are in parentheses, and number of observations are in square brackets. The numbers in bold are the difference-in-differences estimates of the impact of the abolition of the youth minimum wage on 16-17 year-olds' employment and hours worked.

Consistent with the levels and trends shown in Figure 5, both the employment rate and average hours worked of 16-17 year-olds were substantially lower than those of 18-19 and 20-21 year-olds before 2008. The employment rate of each age-group dropped substantially after 2008: for 16-17 year-olds by 7.4 percentage points, and for 18-19 and 20-21 year-olds by 4.7 and 4.5 percentage points, respectively. The difference-in-differences estimates show statistically significant negative impacts of the 2008 youth minimum wage change on 16-17 year-olds' employment rate: equal to -2.7 percentage points (p=0.06) and -2.8 percentage points (p=0.08) relative to 18-19 and 20-21 year-olds, respectively. Compared to the pre-2008 16-17 year-olds' employment rate of 45%, these estimates imply the abolition of the youth minimum wage caused 16-17 year-olds' employment to fall by about 6%.

Average hours worked also declined after 2008 for each of the three age-groups, by approximately 3 hours per week for 16-17 and 18-19 year-olds, and 2 hours per week for 20-21 year-olds. The implied difference-in-differences estimates of the change in 16-17 year-olds average hours worked is +0.11 relative to 18-19 year-olds, and -1.03 relative to 20-21 year-olds, with neither estimate being statistically significant.

B. Regression Analysis of Employment

We now consider estimates of the impact of the 2008 changes on 16-17 year-olds' employment from regression specifications that control for various factors that may vary either across the age groups and/or over time. Ignoring individual and time-subscripts, the basic regression specification we use is as follows:

$$Y = \delta * (Age16\_17 * Post\_2008) + X'\beta + \varepsilon \qquad (1)$$

where Y is the outcome of interest (e.g. employment); *Age16_17* and *Post_2008* are dummy variables equal to 1 for individuals aged 16-17, and for observations which occur after the 2008 policy change (i.e. from 2008Q2 onwards), respectively; X is a vector of covariates that may also affect the outcome; and δ and β are regression coefficients. Our primary focus is on δ, which is the effect of the policy change on the outcome for 16-17 year-olds, conditional on the effects of the X-variables.

Table 4 reports results from alternative regressions, estimated over the 1997–2010 period. We first consider a simple specification that estimates a post-2008 effect on 16-17 year-olds'

employment, controlling for single-year age effects that are constant over the period, quarter-specific effects that are constant across the age-groups, a pre-2003 indicator variable and an interaction between the pre-2003 indicator variable and being a 16-17 year-old. This approach effectively means that the minimum wage impacts are estimated by comparing the change in outcomes for 16-17 year-olds after 2008 to those from 2003-2008 to the same change for 18-21 year-olds, while the data from 1997-2002 is only used to estimate long-run age differences in employment rates (and later possible seasonal and business cycle effects). We do this so our estimates will not be contaminated by the impact of the 2001 minimum wage reforms.

Table 4: Estimated Impacts of Changes in Youth Minimum Wages on Wage and Salary Employment

	No covariates (1)	**Covariates (2)**	**18-19 spillover (3)**	**Proxy controls (4)**	**Separate year effects (5)**	**Announce effects (6)**	**Age-seasonality (7)**	**Age U-rate (8)**	**Age trends (9)**
Age 16-17									
Post-2008	-0.0510**	-0.0463**	-0.0456**	-0.0388**					
	(0.010)	(0.010)	(0.012)	(0.012)					
2008					0.0054	0.0115	0.0094	0.0091	0.0228
					(0.017)	(0.020)	(0.019)	(0.018)	(0.019)
2009					-0.0384*	-0.0369*	-0.0383*	-0.0332+	-0.0209
					(0.016)	(0.016)	(0.017)	(0.020)	(0.019)
2010					-0.0524**	-0.0578**	-0.0641**	-0.0587**	-0.0419+
					(0.019)	(0.017)	(0.017)	(0.019)	(0.024)
Age 18-19									
Post-2008			0.0003	0.0020					
			(0.011)	(0.011)					
2008					0.0330*	0.0385*	0.0371*	0.0365*	0.0497**
					(0.016)	(0.018)	(0.018)	(0.016)	(0.018)
2009					-0.0114	-0.01	-0.0127	-0.0171	0.0032
					(0.016)	(0.016)	(0.015)	(0.017)	(0.016)
2010					-0.0080	0.0070	0.0039	-0.0008	0.0237
					(0.019)	(0.018)	(0.018)	(0.019)	(0.021)
R-squared	0.04	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Observations	161,719	161,574	161,574	161,574	161,574	161,574	161,574	161,574	161,574

Notes: Huber-White standard errors, that allow for arbitrary correlation in individual errors within age-quarter cells, are in parentheses; coefficients followed by +, *, and ** are significantly different from zero at the 10%, 5% and 1% level respectively. All specifications are estimated by OLS. The covariates include dummy variables for individual-age and quarter, gender, marital status, ethnicity, New Zealand born, rural/urban, region of residence, and the relative population size in each age group in each year.

The estimated impact of the 2008 changes on 16-17 year-olds' employment from this specification, presented in column (1), is -5.1 percentage points, which is substantially larger than the simple difference-in-difference estimates of -2.8 percentage points. We next sequentially add control variables for: individual-specific demographic covariates, which include dummy variables for gender, marital status, ethnicity, being New Zealand-born, and both rural/urban and region of

residence, and the relative population size of each age group in each year to control for possible supply-side effects (column (2)); post-2008 effects on 18-19 year-olds' employment to allow for possible spillovers (column (3)); and a dummy variable for whether a proxy interview was used in the HLFS survey (column (4)). The estimated impacts of the 2008 changes on the 16-17 year-olds' employment rate from these specifications vary between -3.9 percentage points and -5.1 percentage points, with each estimate being statistically significant. The estimated effects on the 18-19 year-olds' employment rate in columns (3) and (4) are small (0 and 0.2 percentage points) and statistically insignificant.

The subsequent specifications allow the policy effects on 16-17 year-olds' employment to vary in each of the three years after 2008 (i.e. 2008Q2-2009Q1, 2009Q2-2010Q1, and 2010Q2-2010Q4), and also allow for analogous effects on 18-19 year-olds' employment.

$$Y = \sum_{t=2008}^{2010} \left\{ \delta_{16\_17}^{t} * (Age16\_17 * Year_t) + \delta_{17\_19}^{t} * (Age18\_19 * Year_t) \right\} + X'\beta + \varepsilon \qquad (2)$$

The results in column (5) for this specification suggest that the adverse employment effects for 16-17 year-olds increased over time: from a small and statistically insignificant positive effect (0.5 percentage points) in 2008, to statistically significant negative effects in 2009 and 2010 (of -3.8 and -5.2 percentage points, respectively). In contrast, the effects on the 18-19 year-olds' employment rate were positive and statistically significant in 2008 (+3.3 percentage points), and negative and insignificant in 2009 and 2010.

In columns (6) and (7) of Table 4, we further control for possible effects associated with the announcement of the 2008 changes in December 2007 (column (6)); and age-specific quarter seasonal effects that are constant over time (e.g., different age-specific study patterns; column (7)). Finally, columns (8) and (9) include alternative controls for possible business cycle and/or secular time effects. In column (8), we use the adult unemployment rate to characterise the (aggregate) business cycle and interact it with single-age dummy variable interactions to allow the business cycle employment impacts to vary by age. Finally, as an alternative to the business cycle effects,

in column (9) we control for age-specific linear trends that control for any age-specific secular (linear) trends in employment.[10]

The year-specific estimated policy effects on 16-17 and 18-19 year-olds' employment rates shown in column (5) are qualitatively robust to these alternative specifications. In particular, we consistently find insignificantly positive estimates on the 16-17 year-olds' employment rate in 2008, followed by increasingly negative effects in 2009 and 2010, which are statistically significant except for the estimated 2009 effect in the final specification. Similarly, the estimated 18-19 year-olds' employment rate effects are consistently positive and statistically significant in 2008, and insignificant in 2009 and 2010.

Based on the results in Table 4, we conclude that the 2008 changes to the youth minimum wages had little effect on the 16-17 year-olds' employment rate in 2008, but increasingly negative effects subsequently; in the order of 3-4 percentage points in 2009, and 5-6 percentage points in 2010. There also appears to have been an increase in the employment rate of 18-19 year-olds in 2008 relative to that of 20-21 year-olds, in the order of 3-4 percentage points. The estimated effects on 16-17 year-olds' employment imply increasing minimum wage impacts over time, although we are not sure of an adequate explanation for such a profile. One explanation may be that, rather than laying off existing workers, firms adjusted gradually by reducing their hiring of new 16-17 year-old workers in favour of 18-19 year-olds. If this occurred then we might expect to see an increase in the average age of workers among those 16-17 year-olds employed, however there is little evidence to suggest this.[11] Alternatively, if employers increasingly substitute 18-19 for 16-17 year-old workers, we might expect to find increasingly positive effects on 18-19 year-olds' employment after 2008, while the estimates suggest the opposite.[12]

[10] Given the absence of any obvious employment rate trends in Figure 5 over the 1997 – 2008 period, we expect that the specification in column (8) will be more appropriate. However, the specification in column (9) provides a robustness test for the results.

[11] Using detailed information in the HLFS data extract on respondents' month of birth and the month of survey to estimate the average age of employed workers, we observe a slight increase in the average age of 16-17 year-olds in 2008 – e.g., the average age of employed 16-17 year-olds was 17.0 years in 2007 and 17.1 years in 2010. However, similar increases occur also for 18-19 and 20-21 year olds.

[12] However, if the 18-19 year-old impacts confound positive substitution effects and negative direct minimum wage effects the estimate will be difficult to interpret.

C. Regression Analysis of Other Outcomes from the Quarterly HLFS

We now consider the impact of the 2008 youth minimum wage policy changes on other relevant outcomes. First, Table 5 contains results for weekly hours worked conditional on being (wage and salary) employed, self-employment, whether studying, unemployed, and inactive, each of which are measured quarterly in the HLFS. Given the robustness of the employment results across the various specifications considered, we present results based on the specifications in columns (7) and (8) of Table 4, that exclude and include age-specific business cycle controls, respectively, for each of the various outcomes. These results are presented in Table 5(a) and Table 5(b) respectively, together with the wage and salary employment outcome results presented in Table 4.

Table 5(a): Estimated Impacts of Changes in Youth Minimum Wages on other HLFS Quarterly Outcomes

	Wage & salary employed (1)	Weekly hours worked (2)	Self-employed (3)	Studied: All sources (4)	Studied: Standard questions (5)	Unemployed (6)	Inactive: All sources (7)	Inactive: Standard questions (8)
Age 16-17								
2008	0.0094	-0.876	-0.0031	-0.0163	-0.0066	-0.0002	-0.0202**	0.0015
	(0.019)	(0.622)	(0.002)	(0.016)	(0.017)	(0.008)	(0.006)	(0.010)
2009	-0.0383*	-2.434**	0.0021	0.0013	0.0193	0.0138+	-0.0321**	0.0157
	(0.017)	(0.404)	(0.002)	(0.011)	(0.012)	(0.008)	(0.008)	(0.011)
2010	-0.0641**	-2.579**	0.0002	0.0313**	0.0631**	0.0066	-0.0430**	0.0023
	(0.017)	(0.617)	(0.003)	(0.012)	(0.013)	(0.013)	(0.008)	(0.014)
Age 18-19								
2008	0.0371*	-0.119	-0.0071**	-0.0045	-0.0261*	-0.0002	-0.0011	-0.0016
	(0.018)	(0.472)	(0.002)	(0.019)	(0.013)	(0.010)	(0.008)	(0.013)
2009	-0.0127	-1.425**	0.0009	0.0069	0.0036	0.0034	-0.0091	0.0077
	(0.015)	(0.422)	(0.003)	(0.011)	(0.013)	(0.009)	(0.008)	(0.012)
2010	0.0039	-2.831**	-0.0005	0.0295*	-0.0135	0.0093	-0.0009	0.0116
	(0.018)	(0.679)	(0.003)	(0.014)	(0.015)	(0.014)	(0.007)	(0.010)
R-squared	0.11	0.20	0.01	0.21	0.15	0.02	0.08	0.06
Observations	161,574	82,961	161,574	77,101	161,574	161,574	77,101	161,574

Notes: Huber-White standard errors, that allow for arbitrary correlation in individual errors within age-quarter cells, are in parentheses; coefficients followed by +, *, and ** are significantly different from zero at the 10%, 5% and 1% level respectively. All specifications are estimated by OLS and include the same set of control variables, including age-specific quarterly seasonal effects, as in the specification in Table 4, column (7).

First, column (2) contains the estimated policy impacts on weekly hours worked, which find statistically insignificant effects for 16-17 year-olds in 2008, and significantly negative effects in 2009 and 2010 of 2.5 (Table 5(a)) and 1.2 (Table 5(b)) hours per week. Compared to the 18.8 average hours worked of 16-17 year-olds in the two years before the change, these estimates imply

a fall of 6-14%. There is also some evidence of a statistically significant decline of 1.4-2.8 hours in 18-19 year-olds' average weekly hours in 2009 and 2010, or 5-10% compared to the 2006-07 average of 29.3 hours per week. Column (3) presents the results for the self-employment rate, which show no effects for 16-17 year-olds, and a statistically significant 0.7% lower self-employment for 18-19 year-olds in 2008.

Table 5(b): Estimated Impacts on Other HLFS Quarterly Outcomes with Business Cycle Controls

	Wage & salary employed (1)	Weekly hours worked (2)	Self-employed (3)	Studied		Unemployed (6)	Inactive	
				All sources (4)	Standard questions (5)		All sources (7)	Standard questions (8)
Age 16-17								
2008	0.0091	-0.818	-0.0033	-0.0196	-0.0059	-0.0005	-0.0199**	0.0013
	(0.018)	(0.625)	(0.002)	(0.016)	(0.017)	(0.007)	(0.005)	(0.010)
2009	-0.0332+	-1.192*	0.0032	-0.019	0.0027	0.0255**	-0.0149	0.0246+
	(0.020)	(0.509)	(0.003)	(0.018)	(0.014)	(0.010)	(0.010)	(0.013)
2010	-0.0587**	-1.201+	0.0014	0.0086	0.0445**	0.0199	-0.0248*	0.0127
	(0.019)	(0.726)	(0.003)	(0.021)	(0.014)	(0.014)	(0.010)	(0.015)
Age 18-19								
2008	0.0365*	-0.0915	-0.0071**	-0.0053	-0.0254*	-0.0005	-0.0041	-0.0017
	(0.016)	(0.465)	(0.002)	(0.019)	(0.012)	(0.009)	(0.007)	(0.012)
2009	-0.0171	-0.202	0.0015	-0.0054	-0.0026	0.0128	-0.0182+	0.0171
	(0.017)	(0.515)	(0.003)	(0.016)	(0.014)	(0.010)	(0.009)	(0.014)
2010	-0.0008	-1.382+	0.0003	0.0138	-0.0217	0.0211	-0.0107	0.0232*
	(0.019)	(0.757)	(0.003)	(0.021)	(0.016)	(0.014)	(0.010)	(0.012)
R-squared	0.11	0.20	0.01	0.21	0.15	0.02	0.08	0.06
Observations	161,574	82,961	161,574	77,101	161,574	161,574	77,101	161,574

Notes: Huber-White standard errors, that allow for arbitrary correlation in individual errors within age-quarter cells, are in parentheses; coefficients followed by +, *, and ** are significantly different from zero at the 10%, 5% and 1% level respectively. All specifications are estimated by OLS and include the same set of control variables, including age-specific business cycle effects captured by age-specific interactions with the adult unemployment rate, as in the specification in Table 4, column (8).

The remainder of the table contains results for studying (columns (4) and (5), using the alternative study measures from the HLFS), unemployment (column (6)), and inactivity (columns (7) and (8), also using the alternative measures of studying). There is some evidence that the percent of 16-17 year-olds unemployed increased after 2008, particularly in 2009 by 1.4-2.6 percentage points, but the evidence is relatively weak. Using the standard questions on studying that have been asked throughout the HLFS history, there appears to have been a strong increase in the fraction of 16-17 year-olds studying in 2010, of 4-6 percentage points (column (5)), and little evidence of any impact on inactivity (column (8)). Using the more complete study information that has been collected since 2004, the results show smaller, but still significant, effects of the

Table 6: Effects on Mutually Exclusive Employment, Study and Inactivity

	Wage & salary employed (1)	Study (all sources) (2)	Mutually exclusive & exhaustive outcomes: Work only (3)	Work & study (4)	Study only (5)	Inactive (6)
A: Controlling for age-specific seasonal factors						
Age 16-17						
2008	0.0206	-0.0163	0.0365*	-0.0191	0.0026	-0.0200**
	(0.017)	(0.016)	(0.014)	(0.014)	(0.019)	(0.006)
2009	-0.0264	0.0013	0.0309*	-0.0524**	0.0534**	-0.0319**
	(0.018)	(0.011)	(0.012)	(0.015)	(0.020)	(0.008)
2010	-0.0483*	0.0313**	0.0116	-0.0581**	0.0891**	-0.0426**
	(0.020)	(0.012)	(0.013)	(0.016)	(0.019)	(0.008)
Age 18-19						
2008	0.0401*	-0.0045	0.0056	0.0243+	-0.0290+	-0.0009
	(0.018)	(0.019)	(0.018)	(0.012)	(0.017)	(0.007)
2009	-0.0130	0.0069	0.0022	-0.0145	0.0210	-0.0086
	(0.014)	(0.011)	(0.015)	(0.012)	(0.014)	(0.008)
2010	0.0062	0.0295*	-0.0285*	0.0318+	-0.0027	-0.0006
	(0.019)	(0.014)	(0.014)	(0.018)	(0.014)	(0.007)
R-squared	0.12	0.21	0.14	0.06	0.18	0.08
B: Controlling for age-specific business cycle factors						
Age 16-17						
2008	0.0262	-0.0196	0.0395**	-0.0159	-0.0040	-0.0196**
	(0.017)	(0.016)	(0.014)	(0.014)	(0.018)	(0.005)
2009	0.0279	-0.0190	0.0339+	0.0040	-0.0234	-0.0145
	(0.026)	(0.018)	(0.018)	(0.023)	(0.026)	(0.010)
2010	0.0127	0.0086	0.0162	0.0042	0.0039	-0.0243*
	(0.030)	(0.021)	(0.021)	(0.025)	(0.028)	(0.010)
Age 18-19						
2008	0.0406*	-0.0053	0.0094	0.0209+	-0.0265+	-0.0038
	(0.017)	(0.019)	(0.018)	(0.012)	(0.016)	(0.007)
2009	0.0164	-0.0054	0.0236	-0.0052	-0.0008	-0.0177+
	(0.013)	(0.016)	(0.017)	(0.018)	(0.014)	(0.009)
2010	0.0424*	0.0138	-0.0032	0.0447*	-0.0312+	-0.0103
	(0.019)	(0.021)	(0.021)	(0.022)	(0.017)	(0.010)
R-squared	0.12	0.21	0.14	0.06	0.18	0.08
Observations	77101	77101	77101	77101	77101	77101

Notes: Huber-White standard errors, that allow for arbitrary correlation in individual errors within age-quarter cells, are in parentheses; coefficients followed by +, *, and ** are significantly different from zero at the 10%, 5% and 1% level respectively. All specifications are estimated by OLS over the sample period 2004–2010, and include the same set of control variables, including age-specific quarterly seasonal effects (panel A), and age-specific business cycle effects (panel B), as in the specifications in Table 4, columns (7) and (8).

policy change on study rates of 16-17 year-olds (column (4)), but stronger negative effects on the inactivity rates after 2008 (column (7)).[13]

In order to investigate the contrasting effects of the policy change on the study and inactivity outcomes depending on the measure of study adopted, we have re-estimated various related effects using data from 2004 onwards. In particular, Table 6 contains the estimated effects for wage and salary employment, and studying in columns (1) and (2), and, in columns (3) – (6), the results for the mutually exclusive (and exhaustive) measures of work-only (including both wage and salary, and self-employment), work-study, study-only, and inactivity (i.e. neither work nor study) based on the more complete measure of studying. The results in panel A, which control for seasonal effects, tend to be stronger than those in panel B, which control for business cycle effects. Again, because of the difficulty of identifying business cycle patterns over the 2004-10 period, we focus on the former estimates.

These results show that most of the negative impact of the 2008 minimum wage change on 16-17 year-olds' employment fell on individuals who were both studying and working. Similarly, the positive impact on 18-19 year-olds' employment was also among those studying. This suggests there may have been a substitution of employment opportunities away from younger (16-17 year-old) towards older (18-19 year-old) students. In fact, the results in column (3) show that the employment rate of 16-17 year-olds not studying increased by 3-4 percentage points in 2008 and 2009. In contrast, the increase in the 2008 employment rate of 18-19 year-olds appears to have been largely among those also studying (column (4)). The work-study (column (4)), and study-

[13] We have examined the robustness of the estimated impacts using samples covering different periods, and present the results in the appendix. In particular, Table A1 contains the results estimated over the longer 1986–2010 HLFS sample period for the same outcomes presented in Table 5 (except for the study and inactivity outcomes using the more complete study information collected from 2004 onwards); and Table A2 contains the results estimated over the 2004–2010 period. The estimated impacts of the policy changes are generally qualitatively robust across these three periods. The main exception is in regards to the effects on the wage and salary employment rates of teenagers for the specification that controls for age-specific business cycle factors over the 2004–2010 sample: for this case, the estimated effects on 16-17 year-olds' employment rate is positive but not statistically significant in each year after 2008, and the estimated effects on 18-19 year-olds' employment rates are also positive and significant in 2010 (as well as 2008). We are inclined to discount these findings because the limited variation in the adult unemployment rate between 2004 and 2008 makes it difficult to accurately control for business cycle effects using this approach in this sample.

only (column (5)) results suggest that the employment rate of 16-17 year-olds studying fell by 5-6 percentage points in 2009 and 2010, which was more than matched by an increase in the fraction only-studying.

Table 7: Estimated Impacts of Changes on HLFS-IS Annual Outcomes

	Received benefits	**Log(weekly earnings)**	**Log(weekly income)**
	A: Controlling for age-specific and year-specific factors		
Age 16-17			
2008	-0.022	0.0073	0.0441
	(0.015)	(0.052)	(0.077)
2009	-0.0172+	-0.164**	-0.0445
	(0.009)	(0.040)	(0.047)
2010	-0.0364*	0.0934+	-0.0662+
	(0.014)	(0.051)	(0.035)
Age 18-19			
2008	-0.0261	-0.0265	0.0768
	(0.018)	(0.035)	(0.073)
2009	-0.0177+	-0.117**	-0.0087
	(0.010)	(0.042)	(0.046)
2010	-0.0144	-0.144*	0.0164
	(0.009)	(0.059)	(0.034)
R-squared	0.11	0.32	0.29
	B: Controlling for age-specific business cycle factors		
Age 16-17			
2008	-0.0221+	0.0054	0.045
	(0.013)	(0.051)	(0.065)
2009	-0.0098	-0.084	0.0096
	(0.012)	(0.054)	(0.048)
2010	-0.0232	0.230**	0.0177
	(0.021)	(0.070)	(0.053)
Age 18-19			
2008	-0.0243	-0.0287	0.0765
	(0.015)	(0.039)	(0.066)
2009	-0.0087	-0.0661	0.0201
	(0.013)	(0.052)	(0.047)
2010	-0.0033	-0.0581	0.0617
	(0.020)	(0.072)	(0.053)
R-squared	0.11	0.33	0.29
Observations	36,764	18,169	36,764

Notes: Huber-White standard errors, that allow for arbitrary correlation in individual errors within age-year cells, are in parentheses; coefficients followed by +, *, and ** are significantly different from zero at the 10%, 5% and 1% level respectively. All specifications are estimated by OLS. The specifications in panel (A) include the same set of control variables as in the specification in Table 4, column (7), including age-specific and year-specific effects; while the specifications in panel (B), age-specific business cycle effects captured by age-specific interactions with the adult unemployment rate.

D. Regression Analysis of Other Outcomes from the Annual HLFS-IS

Finally, we consider the impact of the 2008 minimum wage changes on outcomes measured annually in the HLFS-IS: the receipt of non-student benefits, weekly main-job earnings, and weekly total income. Our main set of results for this analysis, estimated over the 1997–2010 period, are presented in Table 7, while Table A3 in the appendix contains the equivalent results estimated over the 2004–2010 period. Each table contains two sets of results: the specification in panel (A) controls for age-specific and year-specific factors, analogously to the specification in column (8) of Table 4, and the specification in panel (B) additionally controls for age-specific business cycle effects. The results are generally qualitatively robust across the two sample periods.

Controlling for age- and year-specific effects, we estimate the fraction of 16-17 and 18-19 year-olds receiving benefits fell significantly relative to that of 20-21 year-olds after the 2008 policy changes. The estimates controlling for business cycle effects, in panel (B), are weaker. The impacts on main-job earnings, as measured by log(weekly earnings), are also generally negative and largely reflect the decline in hours worked shown in Table 4, although they are somewhat sensitive to the specification estimated. The estimates in panel (A) imply 16–17 year-olds' earnings fell by around 15% in 2009, but increased by about 10% in 2010: the latter perhaps reflecting a combination of non-random selection into (non)employment and higher wages among those employed. The estimates in panel (A) imply 18-19 year-olds' earnings fell by 10-15% in 2009 and 2010. Finally, the estimates of the impacts on 16-17 year-olds' total weekly income suggest generally negative but rather muted effects, in the order of 5–10% decline in 2009 and 2010 (panel (A)), but these again depend on the particular specification adopted.

V. Conclusion

We examine the effects of the large increase in the minimum wage for 16-17 year-old workers that occurred in New Zealand in 2008 on employment and related labour market outcomes. The abolishment of the statutory youth minimum wage in 2008 had a substantively large and binding impact on the wage distribution of 16-17 year-olds. Our analysis finds consistent evidence of adverse employment effects of the 2008 policy change for 16-17 year-olds. In our preferred specification, we estimate that the minimum wage increase for this group lowered the employment rate by 3-6 percentage points in 2009 and 2010. However, this adverse effect appears to be entirely due to lower employment among students, with the employment rate of non-students

increasing by around 3 percentage points. Perhaps associated with these effects, we also find evidence of a substitution towards 18-19 year-old student employment, and significant declines in the average weekly hours worked by both groups of teenagers after 2008.

Soon after the implementation of this reform, the global recession hit New Zealand. This had a particularly large impact on teenage employment with the employment rate of 16-17 year-olds falling by one-third from 43.1% in first quarter 2008 to 28.5% fourth quarter 2010. Our results imply that the minimum wage increase explains 20– 40 percent of the fall in employment for 16-17 year-olds with these losses occurring entirely among students who were combining study with part-time employment. Our finding that, even in these circumstances, the adverse effects of a large minimum wage increase are fairly small and primarily impact marginally attached workers suggests that increasing minimum wages are unlikely to cause large employment losses in most circumstances.

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Appendix

Table A1: Estimated Impacts on Quarterly Outcomes, 1986–2010 Samples

	Wage & salary employed	Weekly hours worked	Self-employed	Study	Unem-ployed	Inactive
	(1)	(2)	(3)	(4)	(5)	(6)
	A: Controlling for age-specific seasonal factors					
Age 16-17:						
2008	0.0119	-0.772	-0.0032	-0.0111	0.0013	0.0033
	(0.019)	(0.601)	(0.003)	(0.017)	(0.008)	(0.010)
2009	-0.0337*	-2.293**	0.0023	0.0113	0.0168*	0.0189
	(0.016)	(0.421)	(0.002)	(0.011)	(0.008)	(0.012)
2010	-0.0552**	-2.146**	0.0002	0.0461**	0.0129	0.0102
	(0.017)	(0.631)	(0.003)	(0.012)	(0.012)	(0.012)
Age 18-19:						
2008	0.0400*	-0.0137	-0.0070**	-0.0313*	0.0021	0.0006
	(0.018)	(0.440)	(0.002)	(0.012)	(0.010)	(0.012)
2009	-0.011	-1.342**	0.00076	0.0008	0.0046	0.0089
	(0.015)	(0.444)	(0.003)	(0.013)	(0.009)	(0.012)
2010	0.0057	-2.807**	-0.00095	-0.013	0.0075	0.0099
	(0.019)	(0.699)	(0.003)	(0.015)	(0.014)	(0.009)
R-squared	0.11	0.19	0.01	0.15	0.03	0.07
	B: Controlling for age-specific business cycle factors					
Age 16-17:						
2008	0.0108	-0.762	-0.0034	-0.0077	-0.0006	0.0012
	(0.018)	(0.564)	(0.003)	(0.017)	(0.008)	(0.010)
2009	-0.0279+	-1.672**	0.0037	-0.0053	0.0261**	0.0285*
	(0.016)	(0.453)	(0.002)	(0.012)	(0.008)	(0.012)
2010	-0.0503**	-1.554*	0.0016	0.0327**	0.0201	0.0175
	(0.017)	(0.653)	(0.003)	(0.013)	(0.012)	(0.012)
Age 18-19:						
2008	0.0390*	-0.0696	-0.0072**	-0.0277*	-0.0002	-0.0020
	(0.016)	(0.442)	(0.002)	(0.012)	(0.010)	(0.012)
2009	-0.0074	-0.964*	0.0024	-0.0026	0.0035	0.0068
	(0.015)	(0.479)	(0.003)	(0.013)	(0.009)	(0.013)
2010	0.0109	-2.337**	0.0011	-0.020	0.0081	0.0095
	(0.019)	(0.739)	(0.003)	(0.015)	(0.014)	(0.010)
R-squared	0.11	0.19	0.01	0.15	0.03	0.07
Observations	249,304	125,560	249,304	249,304	249,304	249,304

Notes: Huber-White standard errors, that allow for arbitrary correlation in individual errors within age-quarter cells, are in parentheses; coefficients followed by +, *, and ** are significantly different from zero at the 10%, 5% and 1% level respectively. All specifications are estimated by OLS and include the same set of control variables, including age-specific quarterly seasonal effects (panel A), and age-specific business cycle effects (panel B), as in the specifications in Table 4, columns (7) and (8).

Table A2A: Estimated Impacts on Quarterly Outcomes, 2004–2010 Samples

	Wage & salary employed (1)	Weekly hours worked (2)	Self-employed (3)	Studied: All sources (4)	Studied: Standard questions (5)	Unemployed (6)	Inactive: All sources (7)	Inactive: Standard questions (8)
Age 16-17								
2008	0.0206	-0.608	-0.0025	-0.0163	-0.0102	-0.0036	-0.0202**	-0.0072
	(0.017)	(0.644)	(0.002)	(0.016)	(0.016)	(0.008)	(0.006)	(0.009)
2009	-0.0264	-2.270**	0.0031	0.0013	0.0138	0.0112	-0.0321**	0.0077
	(0.018)	(0.462)	(0.003)	(0.011)	(0.013)	(0.007)	(0.008)	(0.010)
2010	-0.0483*	-2.689**	0.0018	0.0313**	0.0530**	0.0034	-0.0430**	-0.0066
	(0.020)	(0.660)	(0.003)	(0.012)	(0.015)	(0.014)	(0.008)	(0.014)
Age 18-19								
2008	0.0401*	-0.130	-0.0083**	-0.0045	-0.0233+	-0.0023	-0.0011	-0.0066
	(0.018)	(0.444)	(0.002)	(0.019)	(0.013)	(0.010)	(0.008)	(0.013)
2009	-0.013	-1.449**	-0.0003	0.0069	0.0092	0.0019	-0.0091	0.0032
	(0.014)	(0.409)	(0.003)	(0.011)	(0.013)	(0.008)	(0.008)	(0.011)
2010	0.0062	-3.203**	-0.0020	0.0295*	-0.0114	0.0083	-0.0009	0.0082
	(0.019)	(0.690)	(0.003)	(0.014)	(0.016)	(0.015)	(0.007)	(0.011)
R-squared	0.12	0.21	0.01	0.21	0.15	0.02	0.08	0.06
Observations	77,101	39,663	77,101	77,101	77,101	77,101	77,101	77,101

Notes: Huber-White standard errors, that allow for arbitrary correlation in individual errors within age-quarter cells, are in parentheses; coefficients followed by +, *, and ** are significantly different from zero at the 10%, 5% and 1% level respectively. All specifications are estimated by OLS and include the same set of control variables, including age-specific quarterly seasonal effects, as in the specification in Table 4, column (7).

Table A2B: Estimated Impacts on Quarterly Outcomes, 2004–2010 Samples

	Wage & salary employed (1)	Weekly hours worked (2)	Self-employed (3)	Studied: All sources (4)	Studied: Standard questions (5)	Unemployed (6)	Inactive: All sources (7)	Inactive: Standard questions (8)
Age 16-17								
2008	0.0262	-0.429	-0.0022	-0.0196	-0.0123	-0.0059	-0.0199**	-0.0113
	(0.017)	(0.664)	(0.002)	(0.016)	(0.016)	(0.008)	(0.005)	(0.009)
2009	0.0279	-1.756+	0.0066*	-0.0190	-0.0231	-0.0061	-0.0149	-0.0149
	(0.026)	(0.945)	(0.003)	(0.018)	(0.020)	(0.011)	(0.010)	(0.013)
2010	0.0127	-1.970	0.0056	0.0086	0.0122	-0.0154	-0.0248*	-0.0325+
	(0.030)	(1.206)	(0.004)	(0.021)	(0.022)	(0.016)	(0.010)	(0.017)
Age 18-19								
2008	0.0406*	0.278	-0.0086**	-0.0053	-0.0209+	-0.0025	-0.0041	-0.0094
	(0.017)	(0.459)	(0.002)	(0.019)	(0.013)	(0.010)	(0.007)	(0.012)
2009	0.0164	0.989	-0.0004	-0.0054	0.0043	-0.0065	-0.0182+	-0.0228+
	(0.013)	(0.662)	(0.003)	(0.016)	(0.014)	(0.012)	(0.009)	(0.012)
2010	0.0424*	-0.240	-0.0017	0.0138	-0.0187	-0.0012	-0.0107	-0.0228+
	(0.019)	(0.923)	(0.004)	(0.021)	(0.018)	(0.016)	(0.010)	(0.013)
R-squared	0.12	0.21	0.01	0.21	0.15	0.02	0.08	0.06
Observations	77,101	39,663	77,101	77,101	77,101	77,101	77,101	77,101

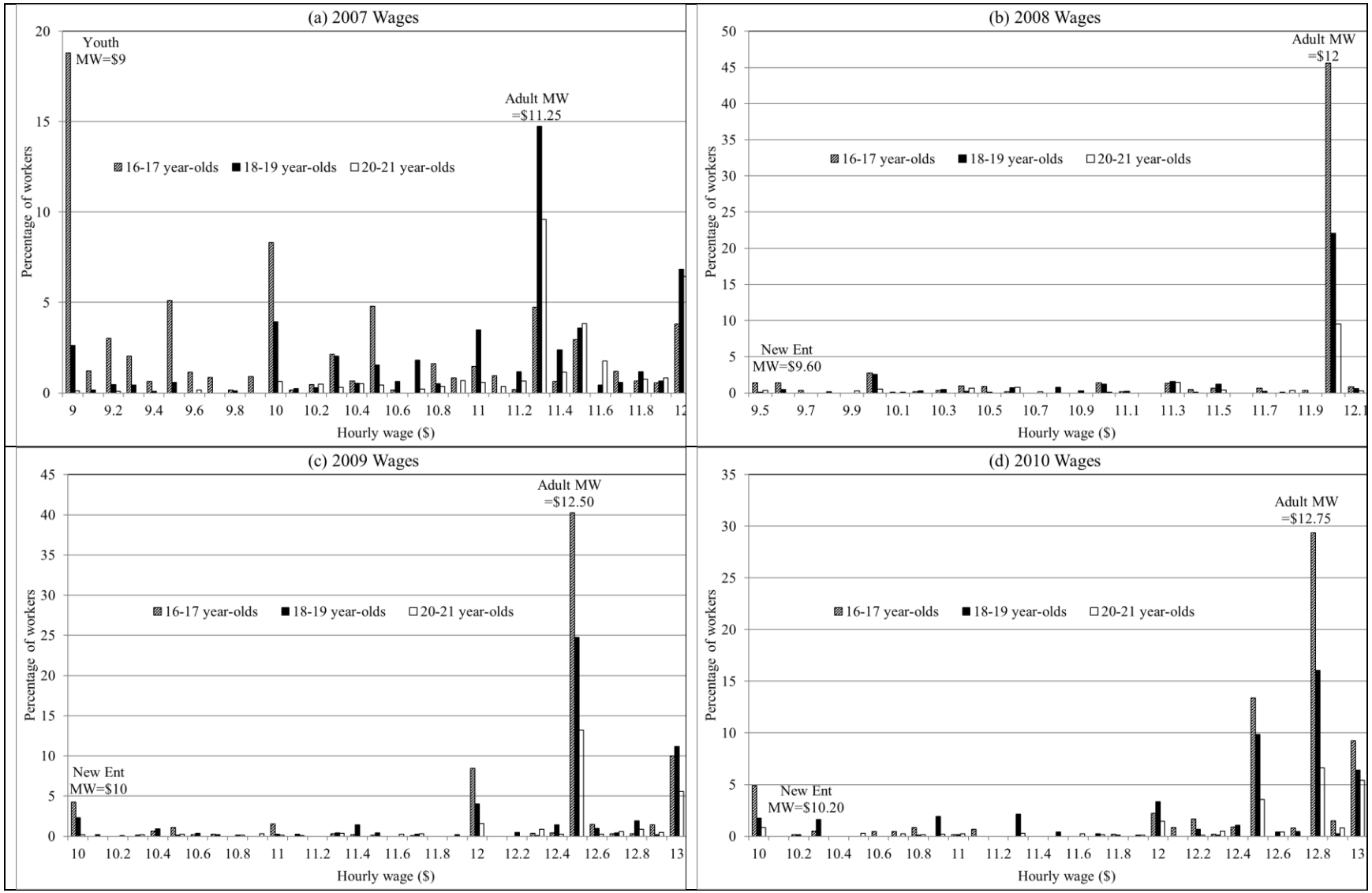
Notes: Huber-White standard errors, that allow for arbitrary correlation in individual errors within age-quarter cells, are in parentheses; coefficients followed by +, *, and ** are significantly different from zero at the 10%, 5% and 1% level respectively. All specifications are estimated by OLS and include the same set of control variables, including age-specific business cycle effects captured by age-specific interactions with the adult unemployment rate, as in the specification in Table 4, column (8).

Table A3: Estimated Impacts on Annual Outcomes, 2004–2010 Samples

	Received benefits	Log(weekly earnings)	Log(weekly income)
	A: Controlling for age-specific and year-specific factors		
Age 16-17			
2008	-0.0273+	0.0264	0.0391
	(0.015)	(0.044)	(0.065)
2009	-0.0302**	-0.142**	-0.0694
	(0.009)	(0.040)	(0.047)
2010	-0.0586**	0.132*	-0.0947+
	(0.015)	(0.056)	(0.056)
Age 18-19			
2008	-0.0345+	-0.0033	0.0556
	(0.018)	(0.039)	(0.065)
2009	-0.0262*	-0.105**	-0.040
	(0.010)	(0.037)	(0.041)
2010	-0.0206*	-0.132**	-0.0103
	(0.009)	(0.049)	(0.041)
R-squared	0.09	0.32	0.29
	B: Controlling for age-specific business cycle factors		
Age 16-17			
2008	-0.0174	0.0664	0.102+
	(0.016)	(0.058)	(0.057)
2009	0.0483	0.134	0.386*
	(0.059)	(0.250)	(0.169)
2010	0.0643	0.550	0.591*
	(0.091)	(0.384)	(0.263)
Age 18-19			
2008	-0.023	-0.0639	0.0292
	(0.021)	(0.040)	(0.064)
2009	0.0767	-0.497**	-0.118
	(0.087)	(0.153)	(0.234)
2010	0.139	-0.732**	-0.117
	(0.134)	(0.238)	(0.367)
R-squared	0.10	0.32	0.29
Observations	17,065	8,413	17,065

Notes: Huber-White standard errors, that allow for arbitrary correlation in individual errors within age-year cells, are in parentheses; coefficients followed by +, *, and ** are significantly different from zero at the 10%, 5% and 1% level respectively. All specifications are estimated by OLS. The specifications in panel (A) include the same set of control variables as in the specification in Table 4, column (7), including age-specific and year-specific effects; while the specifications in panel (B), age-specific business cycle effects captured by age-specific interactions with the adult unemployment rate.

Figure A1: Histograms of Wages between Youth/New Entrant and Adult Minimum Wages, 2007–2010



Source: New Zealand Income Surveys